

BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Western North Atlantic Offshore Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two morphologically and genetically distinct bottlenose dolphin morphotypes (Duffield *et al.* 1983; Duffield 1986) described as the coastal and offshore forms. Both inhabit waters in the western North Atlantic Ocean (Hersh and Duffield 1990; Mead and Potter 1995; Curry and Smith 1997) along the U.S. Atlantic coast. The two morphotypes are genetically distinct based upon both mitochondrial and nuclear markers (Hoelzel *et al.* 1998). The offshore form is distributed primarily along the outer continental shelf and continental slope in the Northwest Atlantic Ocean; however the offshore morphotype has been documented to occur relatively close to shore over the continental shelf south of Cape Hatteras, NC.

Bottlenose dolphins which stranded alive in the western North Atlantic in areas with direct access to deep oceanic waters had hemoglobin profiles that matched that of the offshore morphotype (Hersh and Duffield 1990). Hersh and Duffield (1990) also described morphological differences between offshore morphotype dolphins and dolphins with hematological profiles matching the coastal morphotype which had stranded in the Indian/Banana River in Florida. North of Cape Hatteras, there is separation of the two morphotypes across bathymetry during summer months. Aerial surveys flown during 1979-1981 indicated a concentration of bottlenose dolphins in waters < 25 m deep corresponding to the coastal morphotype, and an area of high abundance along the shelf break corresponding to the offshore stock (CETAP 1982; Kenney 1990). Biopsy tissue sampling and genetic analysis demonstrated that bottlenose dolphins concentrated close to shore were of the coastal morphotype, while those in waters > 40 m depth were from the offshore morphotype (Garrison *et al.* 2003). However, during winter months and south of Cape Hatteras, NC the range of the coastal and offshore morphotypes overlap to some degree. Torres *et al.* (2003) found a statistically significant break in the distribution of the morphotypes at 34 km from shore based upon the genetic analysis of tissue samples collected in nearshore and offshore waters. The offshore morphotype was found exclusively seaward of 34 km and in waters deeper than 34 m. Within 7.5 km of shore, all animals were of the coastal morphotype. More recently, offshore morphotype animals have been sampled as close as 7.3 km from shore in water depths of 13 m (Garrison *et al.* 2003). Systematic biopsy collection surveys were conducted coastwide during the summer and winter between 2001 and 2005 to evaluate the degree of spatial overlap between the two morphotypes. Over the continental shelf south of Cape Hatteras, North Carolina the two morphotypes overlap spatially, and the probability of a sampled group being from the offshore morphotype increased with increasing depth based upon a logistic regression analysis (Garrison *et al.* 2003).

Seasonally, bottlenose dolphins occur over the outer continental shelf and inner slope as far north as Georges Bank (Figure 1; CETAP 1982; Kenney 1990). Sightings occurred along the continental shelf break from Georges

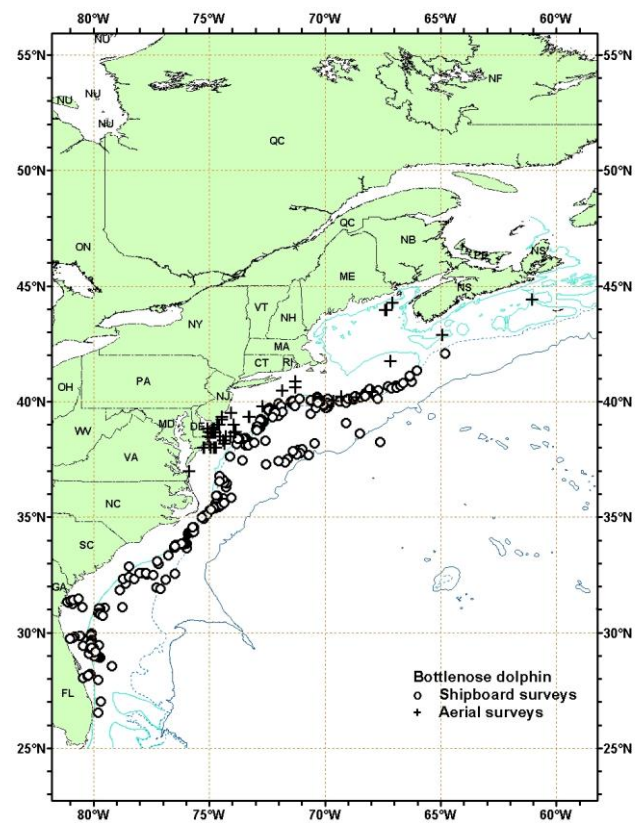


Figure 1. Distribution of bottlenose dolphin sightings from NEFSC and SEFSC aerial surveys during summer in 1998, 1999, 2002, 2004, and 2006. Isobaths are at 100 m, 1,000 m, and 4,000 m.

Bank to Cape Hatteras during spring and summer (CETAP 1982; Kenney 1990). In Canadian waters, bottlenose dolphins have occasionally been sighted on the Scotian Shelf, particularly in the Gully (Gowans and Whitehead 1995; NMFS unpublished data). The range of the offshore bottlenose dolphin includes waters beyond the continental slope (Kenney 1990), and offshore bottlenose dolphins may move between the Gulf of Mexico and the Atlantic (Wells *et al.* 1999). Dolphins with characteristics of the offshore type have stranded as far south as the Florida Keys.

POPULATION SIZE

The best available estimate for offshore morphotype bottlenose dolphins is the sum of the estimates from the June-July 2002 aerial survey covering the continental shelf, the summer 2004 vessel survey south of Maryland, and the summer 2004 vessel and aircraft surveys north of Maryland. This joint estimate provides complete coverage of the offshore habitat from central Florida to Canada during summer months. The combined abundance estimate from these surveys is 81,588 (CV=0.17).

Earlier abundance estimates

An abundance of 16,689 (CV=0.32) bottlenose dolphins was estimated from a line-transect sighting survey conducted during July 6 to September 6, 1998, by a ship and plane that surveyed 15,900 km of trackline in waters north of Maryland (38°N) (Figure 1; Palka, unpublished). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and $g(0)$, the probability of detecting a group on the track line. Aerial data were not corrected for $g(0)$. An abundance of 13,085 (CV=0.40) for bottlenose dolphins was obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38°N) (Fig. 1; Mullin and Fulling 2003). Abundance estimates were made using the program DISTANCE (Buckland *et al.* 2001; Thomas *et al.* 1998) where school size bias and ship attraction were accounted for.

Recent surveys and abundance estimates

During the summer (June - July) of 2002, aerial surveys covering a total of 6,734 km of trackline were conducted along the U.S. Atlantic coast between Ft. Pierce, Florida and Sandy Hook, New Jersey. The abundance of bottlenose dolphins in survey strata was obtained using line-transect methods and distance analysis, and the direct duplicate estimator was used to account for visibility bias (Buckland *et al.* 2001; Palka 1995). These estimates were further partitioned between the coastal and offshore morphotypes based upon the results of the logistic regression models and spatial analyses described above. A parametric bootstrap approach was used to incorporate the uncertainty in the logistic regression models into the overall uncertainty in the abundance estimate for offshore bottlenose dolphins (Garrison *et al.* 2003). The resulting coastwide abundance estimate for the offshore morphotype in waters < 40 m depth was 26,849 (CV=0.193).

An abundance of 9,786 (CV=0.56) for offshore morphotype bottlenose dolphins was estimated from a line-transect sighting survey conducted during June 12 to August 4, 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of 38°N (Table 1; Palka 2005). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and $g(0)$, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for $g(0)$ and biases due to school size and other potential covariates (Palka 2005).

An estimate of abundance obtained from an aerial survey conducted in August 2002 was 5,100 (CV=0.41) offshore morphotype bottlenose dolphins and an abundance estimate of 2,989 (CV=1.11) was obtained from a survey conducted in August 2006. The 2002, 2006 and part of the above 2004 sighting surveys were conducted on the NOAA Twin Otter using the circle-back data collection methods, which allow the estimation of $g(0)$ (Palka 2005). The estimate of $g(0)$ was derived from the pooled data from the three aerial surveys, while the density estimates were year-specific. The 2006 survey covered 10,676 km of trackline in the region from the 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. The 2002 survey covered 7,465 km of trackline waters from the 1000-m depth contour on the southern edge of Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia was not surveyed. The 2004 survey covered 6,180 km of trackline in the region from the 100-m depth contour on the southern edge of Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed.

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths > 50 m) between 27.5 and 38°N latitude was conducted during June-August 2004. The survey employed two independent visual teams searching with “bigeye” binoculars. Survey effort was stratified to include increased effort along the continental

shelf break and Gulf Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and there were a total of 473 cetacean sightings. Sightings were most frequent in waters North of Cape Hatteras, North Carolina along the shelf break. Data were analyzed to correct for visibility bias ($g(0)$) and group-size bias employing line transect distance analysis and the direct duplicate estimator (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for offshore morphotype bottlenose dolphins between Florida and Maryland was 44,953 (CV=0.26).

Table 1. Summary of abundance estimates for western North Atlantic offshore stock of bottlenose dolphins. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).			
Month/Year	Area	N_{best}	CV
Jun-Jul 2002	New Jersey to Florida	26,849	0.19
Aug 2002	S. Gulf of Maine to Maine	5,100	0.41
Jun-Aug 2004	Maryland to Bay of Fundy	9,786	0.56
Jun-Aug 2004	Florida to Maryland	44,953	0.26
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	2,989	1.11

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The minimum population estimate for western North Atlantic offshore bottlenose dolphin is 70,775.

Current Population Trend

The data are insufficient to determine population trends. Previous estimates cannot be utilized to assess trends because previous survey coverage of the species' habitat was incomplete.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for offshore bottlenose dolphins is 70,775. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.4 because this stock is of unknown status and due to the high degree of uncertainty in bycatch estimates (CV can not be calculated). PBR for the western North Atlantic offshore bottlenose dolphin is therefore 566.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual human-caused mortality and serious injury of offshore bottlenose dolphins is unknown.

Fisheries Information

Total estimated mean annual fishery-related mortality for this stock during 2001-2006 is unknown, however mortalities of offshore bottlenose dolphins were observed during this period in the Northeast Sink Gillnet and mid-Atlantic Gillnet commercial fisheries. Detailed fishery information is reported in Appendix III.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeast coast of the U.S. A fishery observer program, which has collected fishery data and information on incidental bycatch of marine mammals, was established in 1977 with the implementation of the Magnuson Fisheries Conservation and Management Act (MFCMA).

Bottlenose dolphin mortalities were observed in the pelagic drift gillnet fishery in 1989-1998. Bycatch mortality estimates extrapolated for each year (CV in parentheses) were 72 in 1989 (0.18), 115 in 1990 (0.18), 26 in 1991 (0.15), 28 in 1992 (0.10), 22 in 1993 (0.13), 14 in 1994 (0.04), 5 in 1995 (0), 0 in 1996, and 3 in 1998 (0).

Thirty-two bottlenose dolphin mortalities were observed in the pelagic pair trawl fishery between 1991 and 1995. Estimated annual fishery-related mortality (CV in parentheses) was 13 dolphins in 1991 (0.52), 73 in 1992 (0.49), 85 in 1993 (0.41), 4 in 1994 (0.40) and 17 in 1995 (0.26).

Although there were reports of bottlenose dolphin mortalities in the foreign squid mackerel butterfish fishery during 1977-1988, there were no fishery-related mortalities of bottlenose dolphins reported in the self-reported fisheries information from the mackerel trawl fishery during 1990-1992.

One bottlenose dolphin mortality was documented in the North Atlantic bottom trawl in 1991 and the total estimated mortality in this fishery in 1991 was 91 (CV=0.97). Since 1992 there were no bottlenose dolphin mortalities observed in this fishery.

Pelagic Longline

The pelagic longline fishery operates in the U.S. Atlantic (including Caribbean) and Gulf of Mexico EEZ (SEFSC unpublished data). Between 1992 and 2006 in Atlantic waters, one bottlenose dolphin was observed caught and released alive during 1993, and one was caught and released alive during 1998. In addition, one bottlenose dolphin was observed taken and released alive in 2005 near the continental shelf break south of Cape Hatteras, NC. No bottlenose dolphin mortalities or serious injuries were observed between 2002 and 2006 (Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield-Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Northeast Sink Gillnet

The first observed mortality of bottlenose dolphins was recorded in 2000. This was genetically identified as an offshore morphotype animal. The estimated annual fishery-related serious injury and mortality attributable to this fishery (CV in parentheses) was 0 from 1996-1999, and 132 (CV=1.16) in 2000. There was one additional observed mortality of a bottlenose dolphin presumed to be from the offshore morphotype in this fishery during 2004. Total mortality estimates for 2002-2006 have not been calculated (Table 2).

Mid-Atlantic Gillnet

Bottlenose dolphin mortalities were observed in this fishery during 1998, 2001, and 2005. In each case, the dolphin was presumed to be of the offshore morphotype based upon its location in deep water over the outer continental shelf. The only prior estimate of total mortality in the fishery was 4 (CV=0.7) for 1998. Extrapolated estimates of total mortality from 2002 to 2006 have not been calculated (Table 2).

Table 2. Summary of the incidental mortality of offshore morphotype bottlenose dolphins (<i>Tursiops truncatus</i>) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).								
Fishery	Years	Vessels	Data Type ^a	Observer Coverage ^b	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet	02-06	unk ^c	Obs. Data Dealer Reports, Logbooks	.02, .03, .06, .07, .04	0, 0, 1, 0, 0	0, 0, unk ^d , 0, 0	0, 0, unk ^d , 0, 0	unk ^d
Mid-Atlantic Gillnet	02-06	unk ^c	Obs. Data Dealer Reports	.01, .01, .02, .03, .04	0, 0, 0, 1, 0	0, 0, 0 unk ^d , 0	0, 0, 0, unk ^d , 0	unk ^d
<p>a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected by the Northeast Fisheries Observer Program. The NEFSC collects landings data (Dealer Reports), and total landings are used as a measure of total effort for the gillnet fisheries. Mandatory vessel trip reports (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery.</p> <p>b. Observer coverage of the Northeast sink gillnet and mid-Atlantic coastal gillnet fisheries are ratios based on the percentage of tons of fish landed.</p> <p>c. Number of vessels is not known.</p> <p>d. Estimates of bycatch mortality attributed to the Northeast sink gillnet and mid-Atlantic gillnet fisheries have not been generated</p>								

Other Mortality

Bottlenose dolphins are among the most frequently stranded small cetaceans along the Atlantic coast. Many of the animals show signs of human interaction (*i.e.*, net marks, mutilation, etc.); however, it is unclear what proportion of these stranded animals is from the offshore morphotype.

STATUS OF STOCK

The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown. The western North Atlantic offshore bottlenose dolphin is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. Average 2002-2006 annual U.S. fishery-related mortality and serious injury has not been estimated, and it is therefore unknown whether or not total mortality and serious injury can be considered insignificant.

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